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UTILITY PATENT APPLICATION TRANSMITTAL
(Only for new nonprovisional applications under 37 CFR 1.53(b))

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First Named Inventor or Application Identifier Peter L. Froeberg

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ADDRESS TO: Assistant Commissioner for Patents
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Washington, D. C. 20231

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. X Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)
2. X Specification (Total Pages 14)
(preferred arrangement set forth below)
 - Descriptive Title of the Invention
 - Cross References to Related Applications
 - Statement Regarding Fed sponsored R & D
 - Reference to Microfiche Appendix
 - Background of the Invention
 - Brief Summary of the Invention
 - Brief Description of the Drawings (if filed)
 - Detailed Description
 - Claims
 - Abstract of the Disclosure
3. X Drawings(s) (35 USC 113) (Total Sheets 12)
4. X Oath or Declaration (Total Pages 5)
 - a. Newly Executed (Original or Copy)
 - b. X Copy from a Prior Application (37 CFR 1.63(d))
(for Continuation/Divisional with Box 17 completed) (**Note Box 5 below**)
 - i. DELETIONS OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
5. X Incorporation By Reference (useable if Box 4b is checked)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. Microfiche Computer Program (Appendix)

12/01/97

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7. ☐ Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
a. ☐ Computer Readable Copy
b. ☐ Paper Copy (identical to computer copy)
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ACCOMPANYING APPLICATION PARTS

8. ☐ Assignment Papers (cover sheet & documents(s))
9. ☐ a. 37 CFR 3.73(b) Statement (where there is an assignee)
☒ b. Power of Attorney
10. ☐ English Translation Document (if applicable)
11. ☐ a. Information Disclosure Statement (IDS)/PTO-1449
☐ b. Copies of IDS Citations
12. ☐ Preliminary Amendment
13. ☒ Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
14. ☐ a. Small Entity Statement(s)
b. Statement filed in prior application, Status still proper and desired
15. ☐ Certified Copy of Priority Document(s) (if foreign priority is claimed)
16. ☐ Other: _____

17. If a **CONTINUING APPLICATION**, check appropriate box and supply the requisite information:
☒ Continuation ☐ Divisional ☐ Continuation-in-part (CIP)
of prior application No: 08/969,632

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UNITED STATES PATENT APPLICATION
FOR
EXTENSIBLE GPS RECEIVER SYSTEM

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EXTENSIBLE GPS RECEIVER SYSTEM

BACKGROUND OF THE INVENTION

5 FIELD OF THE INVENTION

The present invention relates to a mechanism for processing positioning signals such as those received from the Global Positioning System (GPS).

10

ART BACKGROUND

The global positioning system (GPS) has become extremely popular for a number of applications. GPS receivers are now incorporated into a
15 variety of systems including consumer electronic systems in which the location information or time information provided by GPS supplements the other information provided by the system. Thus, more and more industries are realizing the advantages that GPS can provide.

Typically, when a customer, such as an original equipment
20 manufacturer (OEM) develops a particular application of GPS, the GPS manufacturer generates the application code in accordance with the customer's specification. The GPS manufacturer designs and codes the user application of GPS, as the processing performed by the GPS receiver has strict timing and processing requirements that cannot be disturbed by other
25 processing such as the user application processing. Unless carefully written, the execution of customer code can conflict with the GPS processing code. In addition, there is the danger of the user code overriding sections of memory

containing the GPS processing code or GPS data used in processing. Thus, the GPS manufacturer cognizant of these restrictions carefully develops the user application code for a particular customer. This is a time consuming and costly process. It is therefore desirable to develop a system that insulates

5 the GPS processing portion and data from the user application portion such that the user application portion has access to the positioning data generated by the GPS processing portion without the concern that the user application portion will corrupt the GPS processing portion and data of the receiver.

SUMMARY OF THE INVENTION

The apparatus and method of the present invention provides a processing system in which the processor is coupled to a Global Positioning System (GPS) receiver circuitry that receives positioning signals and, in accordance with well known GPS processing techniques, generates the positioning data for access by a user application process executing on the same processor. A firewall is established between the user application process and the GPS process. The firewall prevents the user application process from conflicting with time critical processing by the GPS process and further prevents the user application process from overriding the memory areas allocated to the GPS process.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects, features and advantages of the present invention will be apparent to one skilled in the art from the following detailed description in
5 which:

Figure 1 is a simplified block diagram of one embodiment of the system of the present invention.

Figure 2 is a block diagram illustrating the structure of the processes in accordance with the teachings of the present invention.

10 **Figures 3a and 3b** illustrate one class of GPS objects in accordance with the teachings of the present invention.

Figures 4a, 4b, 4c, 4d, 4e, 4f and 4g illustrate another class of GPS objects in accordance with the teachings of the present invention.

15 **Figures 5a and 5b** illustrate a class of GPS objects in accordance with the teachings of the present invention.

DETAILED DESCRIPTION

In the following description, for purposes of explanation, numerous details are set forth in order to provide a thorough understanding of the present invention. However, it will be apparent to one skilled in the art that these specific details are not required in order to practice the present invention. In other instances well known electrical structures and circuits are shown in block diagram form in order not to obscure the present invention unnecessarily.

10 The system of the present invention provides a user configurable Global Position System (GPS) receiver system in which the user application processing does not interfere with time critical positioning processing. A simplified block diagram is shown in **Figure 1**. The system and methods of the present invention are described below with reference to a GPS receiver.

15 However, it is contemplated that the present invention can be implemented in a variety of positioning system receivers including GLONASS, Loran-C and Pseudo-lite receivers.

Referring to **Figure 1**, a GPS antenna and corresponding receiver circuitry **10** is connected to processor **15** via bus **20**. The processor **15** interacts with the GPS hardware such as the correlators, voltage control oscillator (VCO's) and the like, located in receiver **10** to acquire and track GPS signals transmitted by satellites. Thus, GPS receiver **10** receives GPS signals from satellites under the control of processor **15** acquires and tracks the satellites in order to receive the positioning signals. The processor **15** further

25 processes the positioning signals to generate positioning data. Typically, the positioning data includes a time, angular and distance measurements. The specific data generated can vary according to implementation and is well

known in the art. Furthermore, the control functions performed by the processor to acquire and track signals are well known in the art and will not be discussed further herein.

As is well known in the art, positioning signal processing is time
5 critical in nature. Therefore, delays in processing the positioning signals can cause significant error in the computations. Processor 15 not only performs position signal processing, but also performs user application processing. The code and data for the user application as well as the positioning signal code and data are preferably stored in memory 25, which is coupled to
10 processor 15 via bus 20. It is contemplated that memory 25 may also be coupled to processor 15 through a separate bus (not shown). In addition, the system includes a variety of I/O devices, such as GPS antenna/receiver 10, a display 30 and at least one user input device input device 35, such as a keyboard or mouse. The use of these I/O devices is programmable according
15 to the user application.

Figure 2 is a block diagram illustrating the process structure that enables the positioning signal processing to be performed without encumbrance by the user application processing. The processor is controlled by an operating system which receives the instructions of the executing
20 processes and controls the processor accordingly.

Although not limited as such, in the present embodiment it is preferred that a real-time operating system 205 is used to address the time critical nature of the satellite signal processing. The operating system 205 is connected to the code 210 used to control the input/output devices
25 including the GPS receiver. One example of a real-time operating system is the Vx Works® embedded operating system marketed by WindRiver Systems. The processor processes the satellite signals in accordance with the

GPS process 215. Thus, GPS process 215 interacts in the real-time manner with the real-time operating system 205 to receive positioning signals through I/O control 210 and controls the GPS receiver circuitry through I/O control 210 to accurately acquire and track the satellite signals.

5 As noted above it is desirable to enable the user to configure the system for the user's particular application. Therefore, in order to provide this capability, a firewall 220 is established between the GPS process 215, real-time operating system 205, and the user application 225.

In the present embodiment a virtual machine is used 230 to provide a
10 level of protection from a user application program interfering with the data utilized in the GPS process 215. For example, the virtual machine 230 prohibits the user application process 225 from specifically accessing or corrupting a particular memory location not previously allocated to that application as the virtual machine acquires the application to address a
15 particular memory location using a virtual address. In addition, the application process must have the privilege of accessing that particular address. Thus, virtual machine 230 provides one level of the firewall 250.

A virtual machine is a software computer that executes programs that have been compiled into byte code. As noted above, the virtual machine
20 separates the hardware and system software from the application software. Thus, system independent applications can be developed in any language that has a compiler that generates the virtual machine byte code. Applications once complied with byte code can be downloaded and executed as any processor that executes a virtual machine. One such virtual machine,
25 is the Java Virtual Machine, by Sunsoft, Mountain View, California.

The firewall 250 further is required to prohibit the user application 225 from interfering with the time critical processing of the GPS process 215.

In order to protect against this potential problem, the user application processes, as executed by virtual machine 230, are set to a priority that is lower than the priority of the GPS process 215. For example, this is done by setting the priority of the GPS process to the highest priority in the operating system 205. Thus, any other process, such as the user application process will run at a lower priority, thus insuring that the GPS process 215 executes in a timely manner.

Continuing reference with **Figure 2**, in the present embodiment, an application programming interface (API) 240 is provided to simplify the user task of developing the user application. The API 240 preferably includes a number of functions that are accessible by the user application. In the present embodiment, the system is programmed using object oriented technology, such as C++; alternately the Java language can be used. **Figures 3a and 3b** illustrate the Java objects for getting information to perform routing processes. **Figures 4a - 4g** illustrate objects used to acquire time information from GPS signals. **Figure 5a** is illustrative of GPSfix objects that can be used to get location information, i.e., a "fix". In the present embodiment, it is preferred that the GPSfix classes are constructed as class hardwarefix or simfix, wherein class hardwarefix, when initialized, includes communication between the class and the hardware. Furthermore, the object created receives data from the GPS hardware receiver. Simfix is a class of superclass GPSfix that users can instantiate to obtain a simulated GPS fix. When the class is initialized (e.g., the first time it is used), a simulator is started that propagates meaningful positions over time. Furthermore, the class includes methods to deal with simulation, e.g., defining regions and dynamics of simulated data. Simfix is used to provide an applications developer with a realistic model of GPS data.

It is readily apparent that a system developer can provide a variety of objects to address potential user applications. Thus, the user in this embodiment is further isolated from the operating system 205 through the API 240. The resulting system provides a system readily adaptable by a
5 variety of users for a variety of applications without the concern of interference of the time critical GPS processing.

The invention has been described in conjunction with the preferred embodiment. It is evident that numerous, alternatives, modifications, variations, and uses will be apparent to those skilled in the art in light of the
10 foregoing description.

CLAIMS

What is claimed is:

- 1 1. A positioning system comprising:
2 a receiver configured to receive positioning signals;
3 a processor configured to process the positioning signals in a real time
4 manner to generate positioning data;
5 user application code executed by the processor, said application code
6 configured to access the positioning data;
7 a firewall established between the processor and the user application
8 code, said firewall configured to prevent the user application code from
9 corrupting positioning data and enables the processor to process the
10 positioning signals in real time without interference by the user application
11 code.
- 1 2. The positioning system as set forth in claim 1, further
2 comprising an application programming interface (API), said API configured
3 to access the positioning data as instructed by the user application code.
- 1 3. The positioning system as set forth in claim 2, wherein the API
2 comprises a plurality of objects.
- 1 4. The positioning system as set forth in claim 1, wherein the
2 processor executes a real time operating system (RTOS).

1 5. The positioning system as set forth in claim 1, wherein the
2 firewall comprises a virtual machine.

1 6. The positioning system as set forth in claim 1 wherein the
2 processor comprises positioning code executed by the processor and the
3 firewall comprises setting the positioning code to a higher priority than the
4 user application code.

1 7. In a positioning system, a method for processing positioning
2 signals comprising the steps of:
3 receiving positioning signals;
4 processing the positioning signals in a real time manner to generate
5 positioning data;
6 accessing the positioning data through a firewall that prevents an
7 access from corrupting positioning data and interfering with the processing
8 of the positioning signals;
9 processing the positioning data to generate user application data.

1 8. The method as set forth in claim 7, wherein the step of
2 processing the positioning signals is performed using a real time operating
3 system (RTOS).

1 9. The method as set forth in claim 7, wherein the firewall
2 comprises a virtual machine, said step of accessing comprising the steps of:
3 issuing instructions to the virtual machine;
4 said virtual machine receiving the issued instructions and
5 performing the access in accordance with the issued instruction.

1 10. The method as set forth in claim 7, wherein the firewall
2 comprises the steps of processing the positioning signals at a higher priority
3 than the accessing and processing the positioning data.

1 11. A computer readable medium containing executable
2 instructions which, when executed in a processing system, causes the system
3 to perform steps for processing positioning information, comprising:
4 receiving positioning signals;
5 processing the positioning signals in a real time manner to generate
6 positioning data;
7 accessing the positioning data through a firewall that prevents an
8 access from corrupting positioning data and interfering with the processing
9 of the positioning signals; and
10 processing the positioning data to generate user application data.

1 12. The computer readable medium as set forth in claim 11,
2 wherein the instructions further comprise a virtual machine, said step of
3 accessing comprising the steps of:
4 issuing instructions to the virtual machine; and
5 said virtual machine receiving the issued instructions and
6 performing the access in accordance with the issued instruction.

1 13. The computer readable medium as set forth in claim 11,
2 wherein the step of accessing comprises accessing the positioning data at a
3 lower priority than processing the positioning signals.

ABSTRACT

An extensible Global Positioning System (GPS) receiver system is described. The receiver system isolates user application processing from
5 time critical GPS acquisition and tracking processing in order to insure that GPS acquisition and tracking processing is timely performed. Thus user application processing can be developed without concern of conflict with GPS acquisition and tracking processing.

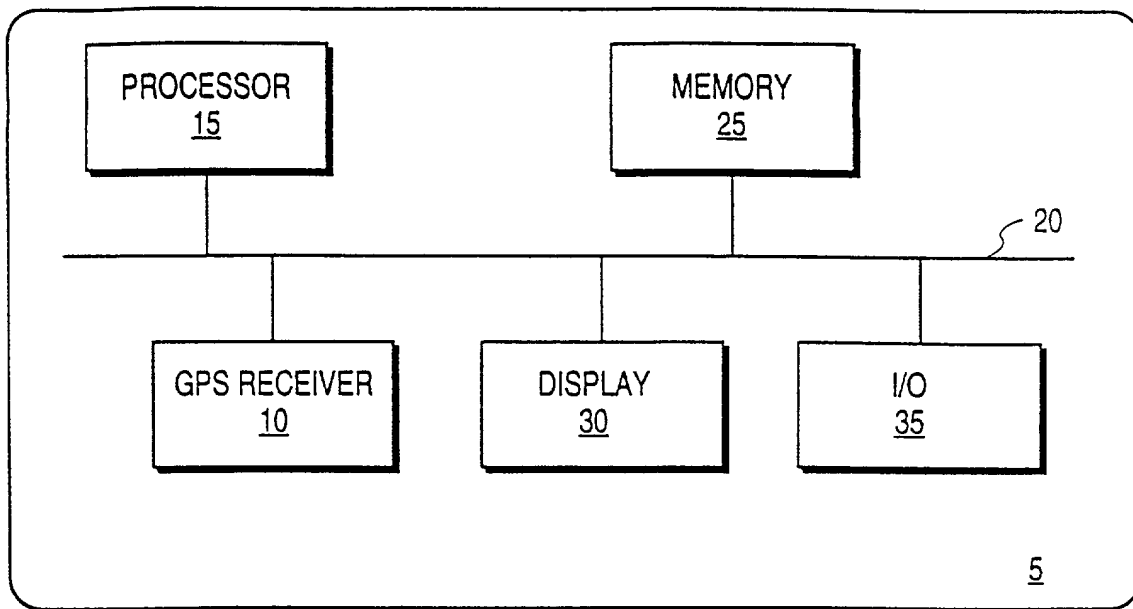


FIG. 1

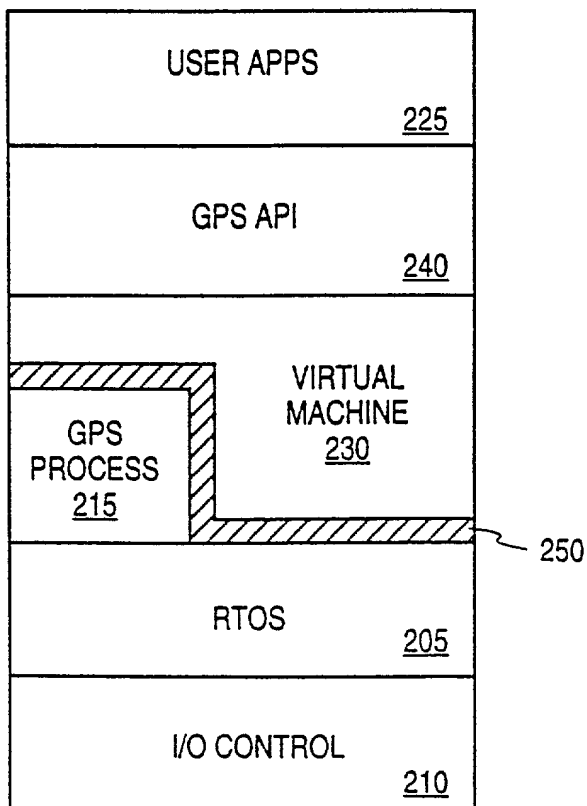


FIG. 2

CLASS GPS.ROUTEPOINT	
METHODS	
-getLat	public double getLat ()
-getLon	public double getLon ()
-getTime	public int getTime ()
-getRadius	public int getRadius ()
-getEarlyThreshold	public int getEarlyThreshold ()
-getLateThreshold	public int getLateThreshold ()
-getDistance	public double getDistance ()
-getIndex	public int getIndex ()
-setTime	
-setRadius	public void setRadius (int radius)
-setEarlyThreshold	public void setEarlyThreshold (int early)
-setLateThreshold	public void setLateThreshold (int late)
-setDistance	public void setDistance (double distance)

FIG. 3a

FIG. 3a is a diagram of a system architecture for a GPS device.

CLASS GPS.ROUTEPOINT	
METHODS	
-setIndex	public void setIndex (int index)
-toString	public String toString () Overrides: <u>toString</u> in class Object

FIG. 3b

FIG. 3b

CLASS GPS.GPSTIME	
VARIABLES	
-SECS_PER_WEEK	public static final int SECS_PER_WEEK
-SECS_PER_DAY	public static final int SECS_PER_DAY
-SECS_PER_HOUR	public static final int SECS_PER_HOUR
-SECS_PER_MINUTE	public static final int SECS_PER_MINUTE
-MINS_PER_HOUR	public static final int MINS_PER_HOUR
-HOURS_PER_DAY	public static final int HOURS_PER_DAY
-DAYS_PER_WEEK	public static final int DAYS_PER_WEEK

FIG. 4a

CLASS GPS.GPSTIME		
CONSTRUCTORS		
-GPSTime	public GPSTime ()	Constructs a GPSTime object with the current date and time
-GPSTime	public GPSTime (int yyyy, int m, int d)	Constructs a specific GPSTime given only the date Parameters: yyyy - year (full year, e.g., 1996, <i>not</i> starting from 1900) m - month (1-12) d - day (1-31) Throws: IllegalArgumentException if yyyy/m/d h:min:ss not a valid date/time
-GPSTime	public GPSTime (int yyyy, int m, int d, int h, int min, float s)	Constructs a specific GPSTime given a date & time Parameters: yyyy - year (full year, e.g., 1996, <i>not</i> starting from 1900) h - hour (range 0-23) min - minute (range 0-59) s - second (range 0-59.999...) Throws: IllegalArgumentException if yyyy/m/d h:ss:ss not a valid date/time

FIG. 4b

CLASS GPS.GPSTIME		
CONSTRUCTORS, cont.		
-GPSTime	public GPSTime (short week_tag, float time_tag)	Constructs a specific GPSTime given the GPS week/second tags. This method corrects for UTC leap seconds and performs GPS week rollover checking according to the current rollover threshold currently in effect Parameters: week_tag - GPS week number (range 0 to 1023) time_tag - Seconds into the GPS week (not adjusted for UTC)

FIG. 4c

CLASS GPS.GPSTIME		
METHODS		
-advanceDay	public void advanceDay (int n)	Advance by n days. For example. d.advanceDay(30) adds thirty days to d Parameters: n - the number of days by which to change this (n can be < 0)
-advanceSecond	public void advanceSecond (float n)	Advance the time by n 'seconds'. For example. d.advanceSecond(30) adds thirty seconds to d Parameters: n - the number of seconds by which to change this day (can be < 0)
-getSecond	public float getSecond ()	Gets the second of the minute Returns: the second of the minute (range 0 to 59.999...)
-getMinute	public int getMinute ()	Gets the minute of the hour Returns: the minute of the hour (range 0 to 59)
-getHour	public int getHour ()	Gets the hour of the day Returns: the hour of the day (range 0 to 23)

FIG. 4d

CLASS GPS.GPSTIME		
METHODS cont.		
-getDay	public int getDay ()	Gets the day of the month Returns: the day of the month (range 0 to 31, month dependent)
-getMonth	public int getMonth ()	Gets the month Returns: the month (range 1 to 12)
-getYear	public int getYear ()	Gets the year Returns: the year (counting from 0, <i>not</i> 1900)
-weekday	public int weekday ()	Gets the weekday Returns: the weekday (0 = Sunday, 1 = Monday, ..., 6 = Saturday)
-daysBetween	public int daysBetween (GPStime b)	The number of days between this and GPStime parameter Parameters: b - any GPStime Returns: the number of days between this and GPStime parameter and b (> 0 if this day comes after b)

FIG. 4e

CLASS GPS.GPSTIME		
METHODS cont.		
-secsBetween	public double secsBetween (GPSTime b)	The number of seconds between this and GPSTime parameter Parameters: b - any GPSTime Returns: the number of seconds between this and GPSTime parameter and b (> 0 if this comes after b)
-getWeek_tag	public short getWeek_tag ()	Get the GPS week_tag Returns: the GPSweek_tag value (aliased to lie from 0 - 1023)
-getTime_tag	public float getTime_tag ()	Get the GPS time_tag Returns: the GPSTime_tag value (offset from UTC by GPS leap seconds)
-convertGPSTimetag	public void convertGPStimetag (short week_tag, float time_tag)	Set this GPSTime to the GPS week/seconds tags. This method corrects for UTC leap seconds and performs GPS week rollover according to the current rollover threshold currently in effect Parameters: week_tag - GPS week number (range 0 to 1023) time_tag - Seconds into the GPS week (not adjusted for UTC)

FIG. 4f

CLASS GPS.GPSFIX		
METHODS		
-clone	public Object clone ()	Makes a bitwise copy of a GpsFix object Returns: a bitwise copy of a SimFix object TBD: sub-objects must also support cloning and be explicitly cloned here. Overrides: clone in class Object.
-getDGPSflag	public boolean getDGPSflag ()	Get the Differential GPS status of the current fix. A TRUE value may be either 2D or 3D.
-GetLatitude	public double GetLatitude ()	Get the latitude in degrees referenced to WGS-84 Positive values indicate northern hemisphere. Negative values indicate southern hemisphere.
-GetLongitude	public double GetLongitude ()	Get the longitude in degrees referenced WGS-84 Negative values indicate western hemisphere. Positive values indicate eastern hemisphere.
-GetAltitudeMSL	public double GetAltitudeMSL ()	Get the altitude in meters above the geoid (mean sea-level)
-getAltitudeWGS84	public double getAltitudeWGS84 ()	Get the altitude in meters above the WGS-84 ellipsoid.
-getTimeTag	public float getTimeTag ()	Get the GPS time tag as seconds within the GPS week.

FIG. 5a

CLASS GPS.GPSFIX		
METHODS cont.		
-getWeekTag	public short getWeekTag ()	Get the GPS week tag (0-1023) from the GPS epoch. This epoch is nominally Jan 6, 1980, but can be adjusted accordingly within the GPSTime class.
-getTimeOfFix	public GPSTime getTimeOfFix ()	Return the UTC (leap-second corrected) time of current fix.
-AgeOfFix	public double AgeOfFix ()	Get the age of the current fix in seconds as compared to (GPS-corrected) system time.
-TimeSincePreviousFix	public float TimeSincePreviousFix (GpsFix prefix)	Return the number of seconds between this fix and the specified (prior) fix.
-GetSpeed	public float GetSpeed ()	Return the horizontal speed in meters per second.
-GetHeading	public float GetHeading ()	Return the current "course" in degrees clockwise from the true north.
-GetVspeed	public float GetVspeed ()	Return the vertical speed in meters per second.
-equals	public boolean equals (GpsFix f)	Return true if fixes are equal.
-print	public void print (String s)	
-print	public void print ()	

FIG. 5b

Attorney's Docket No.: 02240.P048

Patent

DECLARATION FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Extensible GPS Receiver System

the specification of which

XX is attached hereto.
 was filed on _____ as
United States Application Number _____
or PCT International Application Number _____
and was amended on _____
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I do not know and do not believe that the claimed invention was ever known or used in the United States of America before my invention thereof, or patented or described in any printed publication in any country before my invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, and that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (for a utility patent application) or six months (for a design patent application) prior to this application.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

Priority
Claimed

_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)	_____ Yes	_____ No
_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)	_____ Yes	_____ No
_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)	_____ Yes	_____ No

I hereby claim the benefit under title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below

_____ (Application Number)	_____ Filing Date
_____ (Application Number)	_____ Filing Date

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

_____ (Application Number)	_____ Filing Date	_____ (Status -- patented, pending, abandoned)
_____ (Application Number)	_____ Filing Date	_____ (Status -- patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole/First Inventor Peter L. Froeberg

Inventor's Signature Peter L. Froeberg Date Nov 13, 1997

Residence Cupertino, California Citizenship USA
(City, State) (Country)

Post Office Address 22487 Santa Paula Avenue
Cupertino, CA 95014

Title 37, Code of Federal Regulations, Section 1.56
Duty to Disclose Information Material to Patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) Prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

- (1) Each inventor named in the application;
- (2) Each attorney or agent who prepares or prosecutes the application; and
- (3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of:)
)
 Peter L. Froeberg)
)
 Application Number: not yet assigned)
)
 Filed: Herewith)
)
 For: EXTENSIBLE GPS RECEIVER SYSTEM)
)
 _____)

Assistant Commissioner for Patents
 Washington, D.C. 20231

POWER OF ATTORNEY

Trimble Navigation Limited

(Name of Assignee)

("assignee"), a California corporation having a place of
 (State of Incorporation)
 business at 645 North Mary Avenue, Sunnyvale, California 94086,
 (Address)

certifies that to the best of assignee's knowledge and belief it is the assignee of the entire right, title, and interest in and to the above-referenced patent application and represents that the undersigned is a representative authorized and empowered to sign on behalf of the assignee.

Assignee has reviewed the assignment document (copy attached) that evidences the placement of title in the assignee and upon information and belief that the assignment document is being forwarded to the U.S. Patent and Trademark Office for recordation

Pursuant to 37 C.F.R. §§ 3.73 and 3.71, the assignee hereby appoints Aloysius T. C. AuYeung, Reg. No. 35,432; William Thomas Babbitt, Reg. No. 39,591; Jordan Michael Becker, Reg. No. 39,602; Bradley J. Berezna, Reg. No. 33,474; Michael A. Bernadicou, Reg. No. 35,934; Roger W. Blakely, Jr., Reg. No. 25,831; Gregory D. Caldwell, Reg. No. 39,926; Kent M. Chen, Reg. No. 39,630; Lawrence M. Cho, Reg. No. 39,942; Thomas M. Coester, Reg. No. 39,637; Roland B. Cortes, Reg. No. 39,152; William Donald Davis, Reg. No. 38,428; Michael Anthony DeSanctis, Reg. No. 39,957; Daniel M. De Vos, Reg. No. 37,813; Karen L. Feisthamel, Reg. No. 40,264; James Y. Go, Reg. No. P-40,621; Tarek N. Fahmi, Reg. No. P-41,402; David R. Halvorson, Reg. No. 33,395; Eric Ho, Reg. No. 39,711; George W. Hoover II, Reg. No. 32,992; Eric S. Hyman, Reg. No. 30,139; Dag H. Johansen, Reg. No. 36,172; Stephen L. King, Reg. No. 19,180; Dolly M. Lee, Reg. No. 39,742; Michael J. Mallie, Reg. No. 36,591; Kimberley G. Nobles, Reg. No. 38,255; Ronald W. Reagin, Reg. No. 20,340; James H. Salter, Reg. No. 35,668; William W. Schaal, Reg. No. 39,018; James C. Scheller, Reg. No. 31,195;

Charles E. Shemwell, Reg. No. 40,171; Maria McCormack Sobrino, Reg. No. 31,639; Stanley W. Sokoloff, Reg. No. 25,128; Allan T. Sponseller, Reg. No. 38,318; Steven R. Sponseller, Reg. No. 39,384; Edwin H. Taylor, Reg. No. 25,129; Lester J. Vincent, Reg. No. 31,460; John Patrick Ward, Reg. No. 40,216; Ben J. Yorks, Reg. No. 33,609; and Norman Zafman, Reg. No. 26,250; my attorneys; and Robert Andrew Diehl, Reg. No. P-40,992; Sharmini Nathan Green, Reg. No. P-41,410; Thomas A. Hassing, Reg. No. 36,159; Edwin A. Sloane, Reg. No. 34,728; and Judith A. Szepesi, Reg. No. 39,393; my patent agents, of BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP, with offices located at 12400 Wilshire Boulevard, 7th Floor, Los Angeles, California 90025, telephone (310) 207-3800, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

Pursuant to 37 C.F.R. § 3.71, the assignee hereby states that prosecution of the above-referenced patent application is to be conducted to the exclusion of the inventor(s).

Send all future correspondence to Maria McCormack Sobrino,

Reg. No. 31,639, Blakely, Sokoloff, Taylor, & Zafman LLP, 12400 Wilshire Boulevard, Seventh Floor, Los Angeles, California 90025, and direct all telephone calls to the same at (408) 720-8598.

Assignee of Interest: Trimble Navigation Limited

Dated: 11/13/97 By: James M. Janky (Type or Print)
Name: James M. Janky

(Type or Print)

Title: Vice President, Intellectual Property

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Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Dated: November 13, 1997 By: Maria McCormack Sobrino
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